APL Achievement Awards and Prizes

Erin M. Richardson and Linda L. Maier-Tyler

The Johns Hopkins University Applied Physics Laboratory (APL) has a proud history of applying state-of-the-art science and technology to current and future national security challenges. The Laboratory's annual awards program, a 30-year tradition, recognizes and encourages staff members' contributions to solving these critical challenges. The program honors individuals and groups whose work from the previous year advances science, technology, and education as well as innovation within the Laboratory. These achievements take various forms, including innovative thinking that leads to the invention of new technologies, independent research and development projects, and publication in the scientific literature. The winning inventions, projects, initiatives, and publications described on the following pages offer a glimpse into the important contributions APL staff members make every day.

On April 28, 2015, Johns Hopkins University Applied Physics Laboratory (APL) management and staff gathered with local leaders to celebrate the Laboratory's top inventions, innovations, projects, and publications from 2014. Howard County Executive Allan Kittleman declared the day The Johns Hopkins University Applied Physics Laboratory Achievement Awards Day in Howard County.

Among the most prestigious awards presented during the ceremony were those recognizing APL staff members' inventions. For the 2014 competition, APL researchers disclosed 257 inventions. Of these, one was selected for the Invention of the Year Award and one received the Government Purpose Innovation Award.

The Invention of the Year Award was established in 2000 to encourage new technology and innovation at APL. To identify the top technology from the preceding year, invention disclosures are judged by an independent review panel of technical and business consultants, technology transfer professionals, and intellectual property attorneys. The judges assess the inventions' creativity, novelty, improvement to existing technology, commercial potential, and probable benefit to society. This year's winning invention is a technology that promotes nerve growth, significantly advancing capabilities of prosthetic devices by increasing the number of nerve connections.

The Government Purpose Innovation Award was established in 2011 to recognize inventions that have the potential to make significant impact in the defense community and for the nation. This year's winner is a technology that strengthens network defenses through the use of virtualized sensor decoy assets.

This year APL also conferred the rare Master Inventor Award. This award honors staff members who have been granted at least 10 U.S. patents for their APL work. One recipient received the prestigious award in honor of the 11 U.S. patents issued to him during his 15 years of employment at APL. He is only the 26th person in the history of the Laboratory to qualify for this award.

Invention is sometimes confused with innovation. Although the concepts are closely related, invention refers to the creation of a new design, product, or process, and innovation often entails improving on or making a meaningful contribution to something that already exists. The Lab's Ignition Grants program

encourages APL staff to explore innovative ideas that are outside of the organization's traditional programs and processes. Open to all staff, challenges are posted during several cycles throughout the year, and staff members submit ideas for solutions. Winning ideas from each cycle are chosen either through a popular vote or via a "Shark Tank"-like panel, and the finalists receive funding to further develop their ideas. Of the Ignition Grant finalists from 2014, one group received the Ignition Grant Award for Innovation and one group received the Ignition Grant Award for Learning.

Ignition Grants often fund projects that do not relate directly to the Lab's sponsored programs. Of course, developing innovative and effective solutions to sponsors' challenges is a primary goal of APL staff and leadership. The Outstanding Mission Accomplishment Awards recognize major achievements in mission-oriented programs and projects. Awards are given in two categories: a current challenge and an emerging challenge. For both types of awards, a review team of top managers and executives from APL's sectors and mission areas solicits nominations for technical accomplishments achieved in sponsored programs during the previous year. Entries are judged on technical excellence and potential impact.

Oftentimes, independent research and development yields promising results that can be applied to meeting sponsors', and the nation's, most pressing needs. The R. W. Hart Prize for Excellence in Independent Research and Development—established in 1989 in honor of former APL Assistant Director for Research and Exploratory Development Robert W. Hart—recognizes significant contributions that advance science and technology through independent research and development. Sectors and departments recommend candidates, and the Management Forum judges the nominations on the quality and importance of the work to APL. Prizes are awarded in two categories: best research project and best development project. From those projects active in 2014, one prize was awarded in each category.

New this year was the Enterprise Accomplishment Award, recognizing initiatives with the greatest impact on APL's operations and culture of innovation. This award was granted to a group of staff members who developed Central Spark, a creative environment that lets APL staff members explore new ways to creatively solve sponsors' most difficult challenges. Learn more about Central Spark at the end of this issue.

APL recognizes the importance of sharing details of its staff members' inventions, innovations, and advancements. Contributing to the academic literature through publication in books and refereed journals allows others in technical and scientific communities to benefit from and build on others' findings and advancements. To encourage and reward exceptional scholarship, the Editorial Board of the *Johns Hopkins APL Technical Digest* established the Publication Awards competition in 1985 both to promote professional writing and to recognize outstanding publications by the APL professional staff. Departments and sectors may submit up to two nominations in each of six categories. Judges base their selections on significance and clarity, with considerably greater weight given to the significance of the work in advancing science, engineering, or the mission of the Laboratory. In 2014, APL's technical departments and sectors submitted 24 publications from those published in 2014. Of these, six publications, including two books, won honors.

The hard work, excellence, and innovation demonstrated by these technical achievement award winners reflect the qualities that have shaped APL's character since the early days of World War II. Promoting and rewarding scientific discovery, technological innovation, and collaboration is a high priority for the Laboratory. The work of these outstanding individuals not only represents APL's best but also enhances the Lab's capacity to meet evolving challenges to our national security. Award winners' names, along with titles and brief descriptions of their inventions, projects, and publications, are displayed on the following pages.

Jason E. Tiffany, winner of the 2014 Invention of the Year Award.

INVENTION OF THE YEAR AWARD FOR 2014

For "Vertically Grooved Electrode Wells for Nerve Growth Guidance to an Electrode Contact"

Millions of people in the United States live without a limb. Advanced prosthetic technology provides tactile limb feedback and fine motor control, increasing resolution with direct connections to nerves of the peripheral nervous system. This invention uses advances in tissue engineering and nerve outgrowth control to encourage nerve growth into an array of electrode wells, radically increasing the number of interfaced nerves.

Jason E. Tiffany, Senior Professional Staff, Research and Exploratory Development Department, M.S., Chemical Engineering, Arizona State University

Patrick D. Allen, winner of the 2014 Government Purpose Innovation Award. Not pictured: Steven A. Handy.

GOVERNMENT PURPOSE INNOVATION AWARD FOR 2014

For "Deception for Defense: Applying Traditional Camouflage Techniques Adapted to Cyber Network Defense"

This technology strengthens network defenses through the use of virtualized sensor decoy assets that increase the scope, scale, and complexity of a defended environment. The technology takes the initiative away from the adversary by causing confusion and delays in exploitation operations while enabling early detection.

Patrick D. Allen, Principal Professional Staff, Asymmetric Operations Sector (AOS), Ph.D., Operations Research, Colorado School of Mines; **Steven A. Handy,** Associate Professional Staff, AOS, M.S., Electrical and Computer Engineering, Johns Hopkins University

Charles W. Kerechanin II, winner of the 2014 Master Inventor Award.

MASTER INVENTOR AWARD FOR 2014

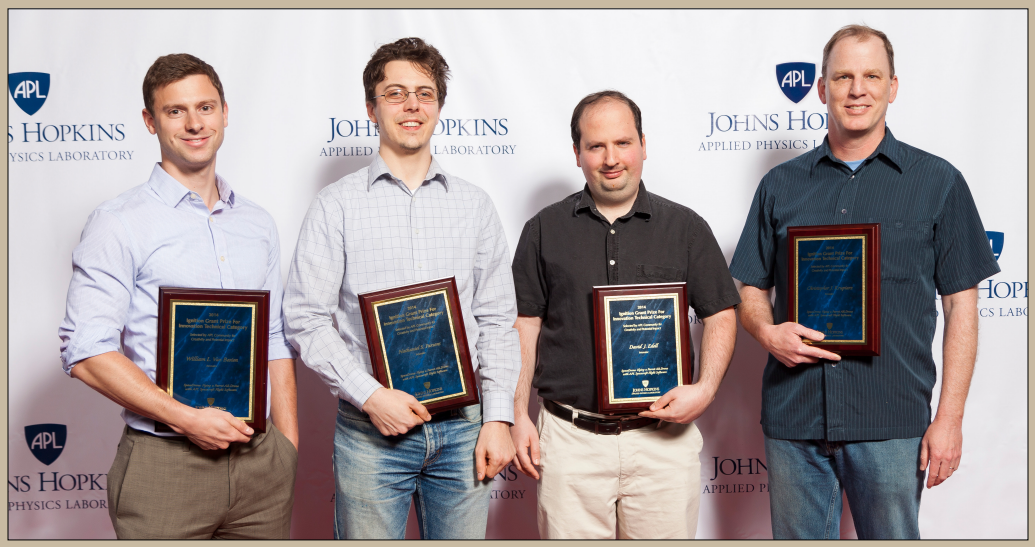
In recognition of his 11 U.S. patents issued during his 15 years of employment at APL, **Charles W. Kerechanin II,** Senior Professional Staff, became the 26th person to qualify for the Master Inventor Award. Charles joined APL in 2000 and is currently a senior mechanical engineer in the Force Projection Sector, where he leads the mechanical design of autonomous sensor systems. Since joining the Laboratory, he has worked on an array of projects for which he holds patents, including several underwater sensors, an environmental monitoring system, a biological sampling device, a man-portable medical ventilator, an anti-fouling coating for cast polymers, and a technique for joining irregular surfaces. He earned both his bachelor's and master's of science in mechanical engineering from Ohio State University in 1998 and 2000, respectively.

IGNITION GRANT AWARD FOR TECHNICAL INNOVATION FOR 2014

For "SpaceDrone: Flying a Parrot AR Drone with APL Spacecraft Flight Software"

Off-the-shelf drones are cheap; spacecraft are not. But drones require many of the same software needs as spacecraft, including control, data handling, and autonomy. The team proposed an innovative use of a commercial unmanned aerial vehicle as a software development platform for testing developmental software for spacecraft.

Christopher J. Krupiarz, Principal Professional Staff, Space Exploration Sector (SES), B.S., Computer Science, Michigan State University; **Nathaniel S. Parsons,** Associate Professional Staff, SES, B.S., Engineering Physics, Cornell University; **David J. Edell,** Associate Professional Staff, SES, B.S., Computer Science, Queens College; **William L. Van Besien,** Associate Professional Staff, SES, M.S., Computer Science, George Washington University



Pictured from left to right: William L. Van Besien, Nathaniel S. Parsons, David J. Edell, and Christopher J. Krupiarz, winners of the 2014 Ignition Grant Award for Technical Innovation.

IGNITION GRANT AWARD FOR LEARNING FOR 2014

For "Development of an Arduino Course"

This hands-on class teaches students how to prototype an idea by using Arduino, a popular open-source electronics prototyping platform.

Tara K. Echlin, Senior Professional Staff, Asymmetric Operations Sector (AOS), M.S., Applied Physics, Johns Hopkins University; **Mars J. Gralia,** Principal Professional Staff, Air and Missile Defense Sector (AMDS), Sci.D., Applied Mathematics and Computer Science, Washington University; **Bruce L. Ballard,** Principal Professional Staff, AMDS, M.S., Electrical Engineering, Johns Hopkins University; **Robert A. Berardino,** Senior Professional Staff, Space Exploration Sector (SES), B.S., Computer and Information Systems, Strayer University; **James J. Bogard,** Senior Professional Staff, Information Technology Services Department, B.S., Computer Science, University of Maryland, Baltimore; **Zaza Soriano,** Associate Professional Staff, AOS, B.S., Electrical and Computer Engineering, University of Central Florida; **Brian T. Taylor,** Associate Professional Staff, AMDS, M.S., Applied Physics, Johns Hopkins University

Pictured from left to right: Zaza Soriano, Tara K. Echlin, Robert A. Berardino, and James J. Bogard, winners of the 2014 Ignition Grant Award for Learning. Not pictured: Mars J. Gralia, Bruce L. Ballard, and Brian T. Taylor.

OUTSTANDING MISSION ACCOMPLISHMENT AWARDS FOR 2014

Current Challenge

For "The ALPHA Project"

This Asymmetric Operations Sector independent research and development project from 2011, known as ALPHA, was transitioned to a high-priority sponsored program that establishes APL as the foremost technical leader in the area of telematics.

Amanpreet S. Johal, Senior Professional Staff, Asymmetric Operations Sector (AOS), M.S., Telecommunications, University of Maryland, College Park; **Amy K. Castner,** Senior Professional Staff, AOS, M.S., Computer Science, Johns Hopkins University; **Paul G. Velez,** Senior Professional Staff, AOS, M.S., Computer Science, Johns Hopkins University; **Eric C. Naber,** AOS, M.S., Computer Science, Johns Hopkins University; **David G. Katz,** Associate Professional Staff, AOS, M.S., Computer Science, Virginia Polytechnic Institute and State University; **John P. Osborne,** Senior Professional Staff, AOS, B.S., Electrical Engineering, University of Massachusetts; Emily Ronald (non-APL staff); **Rodney M. Jokerst,** Senior Professional Staff, AOS, M.S., Computer Science, Johns Hopkins University; **Reuben A. Johnston,** Senior Professional Staff, AOS, M.S., Systems Engineering, George Washington University

Pictured from left to right: David G. Katz, Amanpreet S. Johal, Paul G. Velez, Eric C. Naber, John P. Osborne, and Reuben A. Johnston, winners of the 2014 Outstanding Mission Accomplishment Award for a Current Challenge. Not pictured: Amy K. Castner, Emily Ronald, and Rodney M. Jokerst.

Emerging Challenge

Christopher K. Barker, winner of the 2014 Outstanding Mission Accomplishment Award for an Emerging Challenge. Not pictured: G. D. (Dan) Dockery, Donald E. Chesley, Charles L. Farthing, and Eric R. Thews.

For "Next-Generation Air and Missile Defense Radar (AMDR)"

APL provided systems engineering expertise and technical leadership to develop a transformational capability for the Navy: the next-generation multifunction array radar for the Aegis Combat System on future *Arleigh Burke*-class destroyers (DDG 51) Flight III. With more than 30 times the sensitivity of the AN/SPY-1, AMDR's active-element arrays and digital architecture will provide the unprecedented capability to counter raids of advanced air and ballistic missile threats.

G. D. (Dan) Dockery, Principal Professional Staff, Air and Missile Defense Sector (AMDS), M.S., Electrical Engineering, Virginia Polytechnic Institute and State University; **Donald E. Chesley,** Principal Professional Staff, AMDS, M.S., Electrical Engineering, Drexel University; **Charles L. Farthing,** Principal Professional Staff, AMDS, M.S., Applied Physics, Johns Hopkins University; **Christopher K. Barker,** Senior Professional Staff, AMDS, B.S., Political Science, United States Naval Academy; **Eric R. Thews** (deceased)

R. W. HART PRIZES FOR 2014

Best Research Project

For "Machine Intelligence from Cortical Networks (MICrONS)"

From 3 years of independent research and development on "connectomics," the team developed and demonstrated a world-leading capability to estimate and assess neuronal networks of the brain in a fully automated, scalable framework. This project facilitated strong collaborations within the scientific community and directly led to funding of high-impact research.

William R. Gray Roncal, Senior Professional Staff, Research and Exploratory Development Department (REDD), M.S., Electrical Engineering, University of Southern California; **Dean M. Kleissas,** Associate Professional Staff, REDD, M.S., Mechanical Engineering, Johns Hopkins University; **Mark A. Chevillet,** Senior Professional Staff, REDD, Ph.D., Neuroscience, Georgetown University

Pictured from left to right: Dean M. Kleissas, William R. Gray Roncal, and Mark A. Chevillet, winners of the 2014 R. W. Hart Prize for Best Research Project.

Best Development Project

For "Command and Control of Deeply Placed Capabilities (C2DEEP)"

The C2DEEP independent research and development project resulted in a covert customized satellite communication system that uses existing communication satellites. This development included the waveform design, the software-defined radio implementation, and a demonstration of the capability over an operating link. These successes led to direct funding and an interest from several additional sponsors for continued development.

Steven D. Jones, Principal Professional Staff, Asymmetric Operations Sector (AOS), M.S., Electrical Engineering, Johns Hopkins University; **Jarriel D. Cook,** Senior Professional Staff, AOS, B.S., Electrical Engineering, University of Maryland, College Park; **Jerry R. Hampton,** Principal Professional Staff, AOS, M.S., Electrical Engineering, Johns Hopkins University; **Feng Ouyang,** Senior Professional Staff, AOS, Ph.D., Engineering Physics, Cornell University

Pictured from left to right: Jerry R. Hampton, Feng Ouyang, Jarriel D. Cook, and Steven D. Jones, winners of the 2014 R. W. Hart Prize for Best Research Project.

ENTERPRISE ACCOMPLISHMENT AWARD FOR 2014

For "Central Spark Implementation"

Central Spark is a collection of exploratory areas designed to give APL staff members a creative environment and resources to explore new ways to creatively solve sponsors' most difficult challenges. There are several distinct spaces that make up Central Spark, including Academy Central, Design Central, Maker Central, Media Central, Central Park, and The Loft. Most draw on new and exciting methods of problem solving, such as the maker movement and design thinking. Central Spark is a flexible and evolving facility that will continue to develop based on staff member interests and feedback. Learn more about Central Spark at the end of this issue.

Kristopher A. Bell, Senior Professional Staff, Human Resources and Services Department (HRSD), M.S., General, Johns Hopkins University; **Angelina H. Boampong,** Senior Professional Staff, Information Technology Services Department (ITSD), M.S., Management Information Systems, Bowie State University; **Catherine M. Colangelo,** Senior Professional Staff, ITSD, M.S., Computer Science, Loyola College in Maryland; **Steven F. Ferraro,** Associate Professional Staff, Business and Communication Services Department (BCSD), B.A., Communications, College of Saint Rose; **Wendy S. Hess,** Senior Professional Staff, Plant Engineering Services Department, M.Arch., Architecture, Syracuse University; **Gregory C. Hustead,** Senior Professional Staff, ITSD, B.S., Management Information Systems, Capitol College; **Ann E. Kedia,** Senior Professional Staff, ITSD, M.S., Technical Management, Johns Hopkins University; **Dennis O. Smith,** Senior Professional Staff, ITSD, Ed.M., Personnel, Kent State University; **Donald J. Vislay,** Senior Professional Staff, BCSD, B.A., Communications Studies, University of Maryland University College (expected); **Susan L. Watkins,** Senior Professional Staff, HRSD

Pictured from left to right: Dennis O. Smith, Ann E. Kedia, Catherine M. Colangelo, Susan L. Watkins, Gregory C. Hustead, Donald J. Vislay, Steven F. Ferraro, and Kristopher A. Bell, winners of the 2014 Enterprise Accomplishment Award. Not pictured: Angelina H. Boampong and Wendy S. Hess.

PUBLICATION AWARDS FOR 2014

Matina Gkioulidou, winner of the 2014 Publication Award for Author's First Paper in a Journal or Proceedings.

Author's First Paper in a Journal or Proceedings

For "The Role of Small-Scale Ion Injections in the Buildup of Earth's Ring Current Pressure: Van Allen Probes Observations of the 17 March 2013 Storm," *Journal of Geophysical Research* **119**(9), 7327–7342 (2014)

During a geomagnetic storm in March 2013, the Ion Composition Experiment on the Van Allen Probes observed frequent small-scale injections deep into the inner nightside magnetosphere. Before these observations, the established theory for an increase in ring current during geomagnetic storms was based on transitions in convection due to pressure changes within the global plasma. The authors showed that the net pressure provided by the impulsive sub-storm injections is comparable to the pressure increases predicted by the convection transition model. In fact, they were able to show that the net effect of the numerous observed small injections represented at least 30% of the total ring current enhancement, leading to a reconsideration of the standard ring current intensification model.

Matina Gkioulidou, Senior Professional Staff, Space Exploration Sector, Ph.D., Atmospheric and Oceanic Sciences, University of California, Los Angeles

Outstanding Paper in the Johns Hopkins APL Technical Digest

The Walter G. Berl Award

For "The MSX/UVISI Stellar Occultation Experiments: Proof-of-Concept Demonstration of a New Approach to Remote Sensing of Earth's Atmosphere," *Johns Hopkins APL Technical Digest* **32**(5), 803–821 (2014)

The authors developed a new technique for measuring the distribution of trace greenhouse gases in Earth's atmosphere. This spaced-based technique uses the differential absorption of starlight to obtain ozone profiles as a star is observed to set through Earth's atmosphere. The method was demonstrated using the APL-built UVISI instrument suite aboard the MSX satellite. The technique can be used on small space platforms to explore Earth's atmosphere as well as the atmospheres on other planetary bodies.

Pictured from left to right: Ronald J. Vervack Jr. and Larry J. Paxton, winners of the 2014 Walter G. Berl Award Publication Award. Not pictured: Jeng-Hwa Yee, William H. Swartz, and Robert DeMajistre.

Ronald J. Vervack Jr., Senior Professional Staff, Space Exploration Sector (SES), Ph.D., Astronomy, University of Arizona; **Jeng-Hwa Yee,** Principal Professional Staff, SES, Ph.D., Atmospheric Science, University of Michigan; **William H. Swartz,** Senior Professional Staff, SES, Ph.D., Chemistry, University of Maryland, College Park; **Robert DeMajistre,** Principal Professional Staff, SES, Ph.D., Computational Science and Informatics, George Mason University; **Larry J. Paxton,** Principal Professional Staff, SES, Ph.D., Geophysics, University of Colorado Boulder

Brian D. (David) Clader, winner of the 2014 Publication Award for Outstanding Research Paper in an Externally Refereed Publication

Outstanding Research Paper in an Externally Refereed Publication

For "Quantum Networking of Microwave Photons Using Optical Fibers," *Physical Review A* **90**(1), 012324-1– 012324-9 (2014)

A theoretical model was developed to describe the coupling of microwave photons through optical fibers while still retaining the photons' quantum characteristics. This model addresses the current lack of a scalable technique for the exchange of quantum information between microwave and optical domains. After experimental verification, this technique will allow high-fidelity state transfer between microwave cavities through single-mode optical fibers, enabling a substantial breakthrough in the optical networking of superconducting qubits and, hence, a major step forward in quantum computing.

Brian D. (David) Clader, Senior Professional Staff, Research and Exploratory Development Department, Ph.D., Physics, University of Rochester

Eric J. Adles, winner of the 2014 Publication Award for Outstanding Development Paper in an Externally Refereed Publication. Not pictured: Michael L. Dennis, Timothy P. McKenna, Joseph E. Sluz, Raymond M. Sova, and Radha A. Venkat.

Outstanding Development Paper in an Externally Refereed Publication

For "Blind Optical Modulation Format Identification from Physical Layer Characteristics," *Journal of Lightwave Technology* **32**(8), 1501–1509 (2014)

Because of the ever-increasing demand for data, optical communications networks must use advanced modulation techniques coupled with the highest possible data rates. Typically, network data links are designed for worst-case load conditions and, thus, under normal loads can usually support higher data throughput. The authors developed and tested a technique for the automated identification of optical modulation formats exclusively from the physical-layer characteristics of the signal (with no *a priori* knowledge of the signal). This method is a major step in the development of software-defined optical receivers that can recognize opportunities for increased spectral efficiency and self-configure for optimal data demodulation.

Eric J. Adles, Senior Professional Staff, Air and Missile Defense Sector (AMDS), Ph.D., Physics, North Carolina State University; **Michael L. Dennis,** Principal Professional Staff, AMDS, Ph.D., Optics, University of New Mexico; **Timothy P. McKenna,** Associate Professional Staff, AMDS, M.S., Electrical Engineering, Stanford University; **Joseph E. Sluz,** Principal Professional Staff, Asymmetric Operations Sector, M.S., Engineering, Johns Hopkins University; **Raymond M. Sova,** Principal Professional Staff, AMDS, Ph.D., Electrical Engineering, Johns Hopkins University; **Radha A. Venkat,** Senior Professional Staff, AMDS, M.S., Electrical Engineering, Princeton University

Ralph D. Lorenz, winner of the 2014 Publication Award for Outstanding Professional Book

Outstanding Professional Book

For *Dune Worlds: How Windblown Sand Shapes Planetary Landscapes*, Springer-Verlag, Berlin, Heidelberg (2014)

This book reviews the revolution in understanding of sand dunes on Titan, Mars, Venus, and Earth, via field research, laboratory studies, remote sensing, and computational models. A seminal work in the field of planetary Aeolian geomorphology, the book brings a comprehensive and unifying perspective to one of the most ubiquitous and beautiful landforms seen in planetary exploration. In addition to the sand and wind effects, the book discusses the techniques and instruments with which dunes are studied, how dunes affect the locomotion of vehicles on Earth and Mars, and how dunes' information gives insight into historical climate change on Earth and other worlds.

Ralph D. Lorenz, Principal Professional Staff, Space Exploration Sector (SES), Ph.D., Physics, University of Kent

Nicola J. Fox, winner of the 2014 Outstanding Special Publication Award.

Outstanding Special Publication

For *The Van Allen Probes Mission*, Springer, New York (2014)

This book provides broad and detailed information about NASA's Van Allen Probes twin-spacecraft, Earth-orbiting mission. The book documents the science of the radiation belts and the societal benefits of achieving predictive understanding of their effects. Detailed information is provided about the Van Allen Probes mission design, the spacecraft, the science investigations, and the onboard instrumentation and how they all work together to take measurements within Earth's most intense radiation regions. It is an invaluable contribution to the science of Earth's dynamic space environment and the hazards of the near-Earth particle radiation. This volume is aimed at graduate students and researchers active in space science, solar-terrestrial interactions, and studies of the upper atmosphere and will remain the preeminent resource for the science of Earth's radiation belts for decades to come.

Nicola J. Fox, Principal Professional Staff, Space Exploration Sector (SES), Ph.D., Physics, Imperial College of Science, Technology and Medicine